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ABSTRACT

The three papers included in this report address typography for graphic communication, typographic access structures for educational texts, and typography as macropunctuation. The first paper considers the consequences of an aesthetic bias in the literature of typography, and identifies two misleading assumptions about textbooks; i.e., that print processes are inflexible and finite and that textbooks are continuous prose. The need to de-mystify the printing process is discussed and evidence for selectivity as a strategy of efficient readers is reviewed. The second paper suggests some reasons why the research literature contains very few references to typographic access devices such as contents lists, headings, and glossaries; and suggests that research needs to be more firmly rooted in real-world problems to be truly actionable. A 36-item bibliography is included. The last paper makes a case for the inclusion of graphic and spatial factors in the linguistic analysis of text and in common rules and guidelines for clear writing. Conceptual problems are considered, and a parallel is drawn between the roles of punctuation and typography at the micro- and macro-levels of texts. A 13-item bibliography is included. (CHC)

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Typography for Graphic Communication

[and]

Typographic Access Structures for Educational Texts

[and]

Graphic Aspects of Complex Texts: Typography as Macropunctuation.

Robert Waller

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Typography for graphic communication

A talk addressed to the Kapp Circle of the Institute of Scientific and Technical Communicators on 13 May 1976.

Robert Waller

Abstract

The consequences of an aesthetic bias in the literature of typography are considered and two misleading assumptions about textbooks are identified: that print processes are inflexible and finite and that textbooks are continuous prose. The need to de-mystify the printing process is discussed and evidence for selectivity as a strategy of efficient readers is reviewed. The designer's attention is thus focussed more on the needs of the reader and less on the needs of the printer and the author. The word 'transforming' is suggested to reflect the role of the designer as a mediator in the communication process and the inseparable relationship between what is said and how it is said. The transforming ethos, it is concluded, could redirect the attention of both typographic theory and practice towards a more functional approach.

The designer's role as reflected in the literature

The Tschichold quotation in Fig. 1 is one of the most explicit statements of a view on typography that is implied by numerous books on the subject. It is a view that is reinforced by the way many books on typography are illustrated. Traditional writers on book design often showed only title pages, implying or saying that if you could design that all right, you would have no trouble with the rest of the book. It is interesting to reflect that, although we are to judge a book on its title page, that is the only page in most books which tells the reader absolutely nothing he does not already know. A book is a three-dimensional object, and so it follows that to represent it in two dimensions is to isolate it from its context; this leaves only two criteria by which to judge it - Tschichold's criteria of compatibility with the technical demands of the printing process, and the visual effect.

Tschichold's layout technique is very much like hanging a picture on a wall. Spencer (Fig. 2), in contrast, is hinting at a more sophisticated functional typography. Early proponents of functionalism appear to have viewed technical excellence as a means to an aesthetic end. In my view really functional typography is in fact invisible; that is, it can be judged not by its visual appearance, but only in relation to objectives. Rather than use new means to the same end, the end itself is dependent on the individual circumstances of a particular job, while the same means are at the designer's disposal.

Spencer points to the idea of making the structure of the information contained in a text visible to the reader. Alsleben (Fig. 3) amplifies the point. It is significant that Tschichold is writing about book design, and Spencer about business printing; Alsleben is described as an information theorist. So these quotations, although admittedly out of context, reflect two different approaches to typography - the first largely based on the continuous prose of book publishing, the other on structured information. We shall come back to these later.

An aesthetic bias

These two approaches are reflected in two ways in which the word 'design' is used by typographers. Design in many people's minds means applied or decorative art. Historically, the job description 'Graphic designer' is descended from 'commercial

artist'. When we talk about design for information printing, though, we are using the other sense. Clifford Burke in his marvellous little book 'Printing It' has said "Design, in the sense that I use the word, is like the designs you have on your girl or boyfriend ... I don't intend to use the word in the sense of creative art, but in the more mundane sense of planning."

But it seems to me that the greater number of books about typography restrict the planning part of design to the planning of a printing operation. The planning of book production in this context, though, is just a means to an end - that is, design as creative art. Design as planning can mean so much more - the planning of an information display, the planning of a reading activity and so on.

Consequences of an inadequate literature

To come straight to the point, it does appear that the "knowledge-base" from which typographic designers are trained is derived from an approach to design that is not adequate for the demands of information printing in the 1970s. This rather arrogant declaration is not, of course, intended to mean that all design education is substandard. Design education is saved by its heavy reliance on project work and tutorials; ideas and skills are thus transferred experientially rather than through books. Nevertheless, there is no doubt that too many books and magazines on design reflect a formalist or decorative approach as distinct from a truly functional one. The examples in Fig. 4-7 contrast the formalist approach to design, with some of the problems of modern information publishing.

Of course, if good design is taught experientially, an inadequate literature will not have very much effect on the quality of design as it is practised - sensitive and skilled individuals will have few problems in producing excellent work. But the problem of quality arises when the organisational structure in which individuals work prevents them from exercising their personal skills to the best effect. Unfortunately this is a trend of the modern world - the world of large institutions and bureaucracies. When almost any function is taken over by a large organisation the tendency is to rely less and less on the judgement and skill of individuals and more and more on standard procedures and routines. We all know the result of local government reorganisation in 1974, for example. The point is that to routinise jobs normally done

by skilled individuals you need a first class analysis of the particular task or process, first class operational procedures and adequate provision for feedback, evaluation and improvement. It is in these situations that an inadequate literature will have serious consequences. It is from the literature of a subject area that we form a framework with which to conceptualise and analyse problems. Paul Rand has said "The absence in art of a well-formulated and systematized body of literature makes the problem of teaching a perplexing one."

It may appear that the problem of formulating operational procedures and the world of typographic design are unrelated. Most of the design we hear about, after all, is done by independent practitioners or design groups. It is, however, in the design activity that we don't hear about that the problem lies. Information is big business now but only a tiny proportion of information communicated on paper receives the attention of a designer. The fact that the graphic design profession has publicly projected itself as having a role more cosmetic than functional means that most of the printed information we use to further science and technology, display rules and regulations, communicate information for the administration of government, industry and our personal lives, is, the voice of my training insists, less efficient than it might be if typographers were involved.

Two misleading assumptions

The Open University is the institution I know best, and it is probably not untypical of many large bureaucracies employing designers. Although we have a large studio - about 30 designers in all, not including photographers and picture researchers - typography plays a relatively minor role in the production of our educational texts. Design activity is confined mainly to illustration and cover design, and it is difficult for designers to consult with authors. I will not go into the complex reasons for this now, but a quick look at the guidelines available to our designers for making decisions about the layout of texts will be useful. It shows that their relatively poor placing in our organisational structure is due very much to the poverty of our vision of the potential contribution design could make to the educational process.

Decisions about Open University typography seem to be based on three considerations. There is a house style, much like house styles used by other publishers. There are technical and economic constraints imposed

by the printing processes we use. Then there are precedents - unwritten but nevertheless real rules that deter innovation with the "It was good enough for your father" style of argument.

The limitations of the latter consideration are self-evident. Fig. 8 shows an example of what I mean. We have to continually watch, though, that this sort of blind conservatism is not present in over-large amounts when we think about house style and printing technology. It is in fact present in both at the Open University, and probably elsewhere, although in different ways. We make two assumptions that, in my view, interfere with the quality of our communication: we regard printing processes as inflexible, finite, and unchangeable; and our house style seems to assume that we are in the business of ordinary book publishing.

Demystifying printing

Rank Xerox publicity sometimes includes a photo of an electrostatically printed fried egg - a symbol of the boast of modern print technology to print anything on anything. Book design, though, is still based largely on nineteenth century and earlier technology. I am not, of course, saying that Open University courses should be delivered by the milkman, but I am suggesting that typographers and those who use the services of typographers should demand a breakdown of the elaborate mystification of the printing process that now exists. The lack of standard terms and measurements systems for the specification of print is one manifestation of this; another is the complicated demarcation in the printing industry. It is interesting to see how frustration with the mystifying business of dealing with printers is now the force behind the latest developments in the printing industry. "In-house" printing is the fastest growing area in the industry. The simplification of previously complex processes has brought the originator of a communication closer to the reader. Simpler techniques of composition, correction, plate-making, machining and finishing are now being used by professional printers as well as the less-skilled in-plant operators.

This mystification affects the quality of design in a number of ways. Laying out a page becomes a needlessly complicated job when you have to tell someone else how to do it, using an inadequate

specification system that is not standardised. 'Leading' is old-fashioned, and so not strictly accurate, but how many printers understand 'line-feed'. 'Unjustified', 'ragged edge' and 'ranged left' all mean the same thing; so does 'flush left' and it's not a bad idea. Lack of information about technological options can also result in inappropriate policy decisions by managers. At the Open University, for example, texts can be set in one type style only - i.e. the seven founts on a Monotype keyboard. This decision, which prevents the use of a smaller size for footnotes for instance, or a sans-serif for subheadings, saves a minute proportion of our print budget, but severely limits the typographer's range of graphic devices. The decision was taken on the basis of the long time it takes for a Monotype operator to change his machine to a different face; it was apparently never considered that most large printers have more than one composing machine, or that new systems are available that allow the designer a far greater number of founts than the Monotype.

In theory at least printing technology no longer imposes such rigid constraints on the designer. It can do most things we ask of it; and if print buying and specification can now be made easier, then designers are freed to pay more attention to the business of communication.

Fig. 3 quoted Alsleben as saying that the strongest contribution typography can make to the effectiveness of a communication is to make its structure visible. Do all communications have such a structure?

Designing for one active reader

In some written texts the structure is contained entirely in the prose - a logical sequence of events, concepts or arguments. In other words, there is only one entry point to the text - the beginning - and only one way through. The reader relies entirely on the author's use of language and logic. Examples of such single-track discourse are novels, programmed-learning texts, and other carefully-sequenced instructions such as knitting patterns. In these cases - where there is no visible structure for the typography to display - the designer is free to do as he likes, within the bounds of particular production techniques, his budget, and the limits of the reader's perceptual processes. It is, incidentally, in this last area that most legibility research has been concentrated.

It is texts that do not come into this category that are most in need of the designer's attention - texts where the visual structure is important for the understanding of the content, texts that are to be used in ways other than straight continuous reading. Almost all textbooks come into this category, and yet the traditional practices of book design and editing do not make this important distinction - between texts that assume a passive reader (externally, at least) and texts that require an active, selective reader.

Efficient readers are selective

Selectivity is coming to be seen as a vital component of reading to learn. There are a number of reasons why. Studies of the reading process used to look almost exclusively at the letter, word and sentence level, but researchers are beginning to look at the way people learn from complete books; they have found that the most efficient readers of textbooks do not simply read through the text in a steady linear fashion (even when it is written in that way). Efficient readers scan for the overall structure of the argument, go back to check on things they have not fully understood, and so on. This is, of course, exactly what the speed-reading people have been saying for years - the most efficient readers read for a definite purpose and with a conscious strategy. This model of the reading process makes it quite clear that a visible structure makes this kind of reading easier. This visual structure is the readers' access to the teacher's discourse.

Linked to this is the evidence of researchers into learning styles. Again they are telling us what many people knew - that students prefer to adopt learning strategies suited to their own temperaments, situation and previous knowledge. Their preferred style may not match the teaching style of the textbook - the reader, for instance, may prefer to have an overview of the conceptual structure of a subject area before proceeding to details and examples, whereas the author of a textbook may start with many seemingly unrelated details in order to tie them together into an overview at the end. More pragmatic causes of reading problems come when students have far more reading to do than they have time available - when revising, or when falling behind. Once more, the provision of a visual structure will enable students to access any part of the text that suits them. It is the only way to solve the problems of many non-fiction texts, caused by the inherent linearity of prose.

How to improve!

To summarise, the traditional design and editing of textbooks has often been based on inappropriate assumptions about printing techniques and about the way textbooks are read. But what would more appropriate design and editing procedures look like? How can designers and editors improve the quality of textbooks as instruments of learning? This important notion of quality is essentially related to standards; and standards are determined in two main ways: by empirical observation (research) and by the conceptual framework and values of the observer.

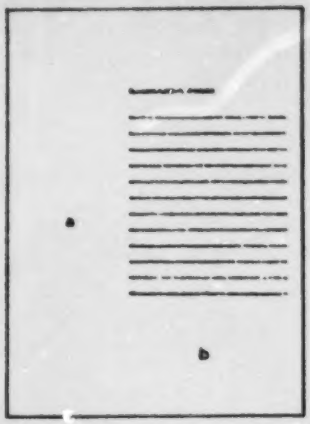
To identify the designer's 'options for quality' is still a major research task and there is currently a lively debate about the way to do it. Typographic researchers have investigated many detailed aspects of text layout, but their results have never been regarded as useful sources of advice by practising designers. Research has not yet told us even in general terms what sort of things make what sort of differences to what sort of people. Until researchers come up with some realistic performance standards for design to add to the aesthetic standards, design will continue to be generally regarded as peripheral to the communication process.

Role-perceptions and environment of the designer can change

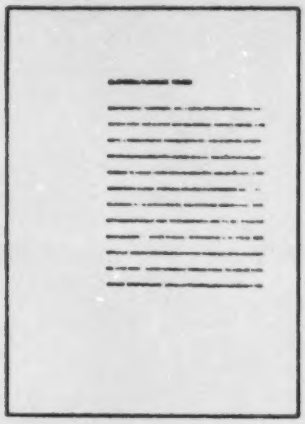
The right kind of research and the right application of its findings depend very much on the values and perceptions of the people producing textbooks, and on the way they work together to transform author's manuscripts. The word 'transform' was introduced by Otto Neurath of the Isotype Institute and is one we have been 'plugging' recently because it expresses the notion that designers, editors, print buyers and, at the Open University, educational technologists are mediators in the communication process. This means that it is impossible to consider the tasks they do as completely separate. To divide them is to take away from each individual the responsibility for the effectiveness of the whole; editorial standards thus become merely stylistic and design standards based on visual aesthetics and fashion. Transforming a text involves, among other things, balancing or reconciling positive purposes or goals and negative constraints (an example in the realm of printing might be print quality versus unit cost) - but whose purposes and whose constraints? If the people producing the textbook are responsible in some way for its effectiveness, then their purposes and constraints will derive not only from production

processes, house style and tradition, but also from the needs and limitations of the reader. Marie Neurath has described Isotype Institute transformers as 'trustees of the reader'.

The quality of typography as part of the communication process is dependent ultimately, then, on an ethos that directs the attention of designers and researchers towards the right goals and enables them to work together in the right way; the right way and the right goals will only be achieved if the activities of design and design research are seen as transforming activities.



4



5

Yet our layout can be improved even further. It looks better if it is placed a little higher (Example 6). The heading looks better if it is moved up a little, for this makes the page look less ponderous and relates the type area better to the space (Example 7). In order to avoid the rigidity of Example 5 we could (Example 8) give the heading the same indentation as the paragraphs of the text, say 12 points. Em indentations are still the best means of indicating paragraphs and are not at all 'old-fashioned'. But this makes the design rather weak. It can only be improved by an unusually strong indentation (Example 9). Let us therefore try indenting the main text the same amount as the heading (Example 10). This is better on the whole. But the heading is now very prominent and calls for a counterweight at the bottom. If we cannot make one (a page-number, for example) we must give up the idea of putting the heading in this position. However, the solutions 6, 7, 9 and 10 are not the only possibilities. We can move the type area, for example, even higher and move the heading further away. Even the smallest change gives a new look. The layout can be made to look different by further increasing the indentation, by putting more space between two paragraphs, etc.

We must ask ourselves each time whether the result is *pleasing*, whether we have achieved a balance. Provided the work is all right technically, there is no other criterion for typographical design.

Fig 1 Tschichold 1934 (quoted in Maclean R. Jan Tschichold: Typographer. Lund Humphries 1975)

Fig 2 Herbert Spencer in Design for Business Printing Lund Humphries 1952

and it is, I think, the growing awareness of this that is the reason why the word 'typography' is being increasingly adopted in place of 'layout'. 'Layout' seems to imply the arranging of *masses*, with type-matter considered as 'areas' and type as something to be stretched or compressed to form a pattern. But 'typography', in this connection, suggests the arranging of type considered three-dimensionally, with the overall design evolving out of the sympathetic handling of detail. 'Layout' suggests a façade; 'typography', a structure.

Alsleben: "As a rule the message of a text can be seized the more readily
the easier it is to see how each part of the text relates to the context of the whole
That is, it pays to show the structure of a text.
Certain typographic resources allow it to be displayed with less trouble
than composition and typeface can do alone."

"One task of typography is exemplified by a table of contents:
imagine a table of contents as a continuously set text,
without paragraphs or indentations;
it would have to be read and reread before any idea of structure came through.
Imagine, too, what an effort it would cost
to rectify this limitation with words of explanation.
This explanatory function is taken over by typographic means."

Fig 3 Kurt Alsleben,
(quoted in Gerstner K. Compendium for Literates MIT Press. 1974)

Fig 4 from the Universities' Superannuation Scheme Explanatory Booklet 1975

9. Pensions on Ill-health Retirement

In the event of retirement before Normal Retirement Age of a member who has become, in the opinion of his employing Institution, incapable of discharging his duties by reason of permanent ill-health or incapacity, provided the member has completed five years' Pensionable Service, a pension is payable at the rate of 1/80th of his Pensionable Salary for each Year of his Pensionable Service provided that:

(a) if Pensionable Service exceeds 20 years it is increased to the notional number of Years of Pensionable Service the member could have completed by his Normal Retirement Age or by 6⅔ years whichever is the smaller;

(b) if Pensionable Service is less than 20 years but more than 10 years it is increased to 20 years or by 6⅔ years whichever is the greater subject to a maximum equal to the notional number of Years of Pensionable Service the member could have completed by his Normal Retirement Age;

(c) if Pensionable Service is less than 10 years but more than 5 years it is doubled subject to a maximum equal to the notional number of Years of Pensionable Service the member could have completed by his Normal Retirement Age.

The Trustee Company has power to withdraw, suspend or reduce an ill-health pension if the member's health improves or if he becomes able to carry on remunerative employment.

If ill-health retirement takes place after less than five years' Pensionable Service have been completed the member is only entitled to benefit as if he had withdrawn from service as outlined in paragraph 21 below.

10. Early Retirement Pensions

A member who has attained age 50 and completed five years' Pensionable Service and who retires before Normal Retirement Age at the request of his employing Institution (or a member who retires on account of redundancy) or a member who has attained age 60 and completed five years' Pensionable Service and who retires with the consent of his employing Institution receives a pension calculated at the rate of 1/80th of his Pensionable Salary for each Year of Pensionable Service up to the date of retirement. If retirement is after age 60 but before Normal Retirement Age but is without the consent of the member's employing Institution then, provided five years' Pensionable Service have been completed, an immediate pension may be granted calculated at the rate of 1/80th of Pensionable Salary for each Year of Pensionable Service but subject to an appropriate actuarial reduction.

11. Late Retirement Pensions

In the event of a member continuing in service after Normal Retirement Age with his employing Institution's consent and then retiring, a pension becomes payable equal to the pension that would have been payable if retirement had been at Normal Retirement Age but actuarially increased to allow for the member's age at retirement.

Such actuarial increases depend to some extent on the financial conditions prevailing at the time but would normally be 1 per cent for each complete month between attainment of Normal Retirement Age and the date of actual retirement.

If the member has contributed to the Superannuation Scheme after his Normal Retirement Age, subject to Inland Revenue limits, a further amount of pension becomes payable related actuarially to the extra contributions paid by the member.

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Expo Montreal 67, Czechoslovakian pavilion, synchronous projection screen 11 x 7 yds, with 15 000 slide projections in black-and-white and colour / Tschechoslowakischer Pavillon, Synchron-Projektions-Wand 10 x 6 m, mit 15 000 schwarz-weissen und farbigen Dias-Projektionen / Pavillon tchécoslovaque, écran synchrone 10 x 6 m, avec 15 000 images projetées en noir, blanc et couleur, Josef Svoboda, Prague / Prag, 1967

Fig 5
Two extracts from Müller-Brockmann J.
A History of Visual Communication
Tiranti 1971

Figures 4 and 5 show complex information laid out formally, with no attempt to use typography to make the structure clear

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Fig 6
from the Great Northern Railway's Rules and Regulations, April 1955

73. If any Train or Engine be discovered at a stand on the opposite Line, not at a Station, the Engineman must sound his Whistle, and reduce his speed so as to be able to stop, if necessary, before reaching the other Train or Engine. During a fog or snow-storm, the Whistle must be sounded frequently during the whole journey; and when approaching any Station or Level Crossing, more than usual precaution must be used; and if the Signals, from fog or any other cause, *be not clearly seen*, the driver must bring his train to a stand before entering the station, and afterwards proceed with great caution until he knows the line is clear.

Driver to reduce speed if the next Train or Engine standing on Line.

To sound Whistle frequently in a Fog, &c.

To stop, and afterwards proceed cautiously if Signals cannot be seen.

74. Should an Engine with a Passenger Train become disabled, the Driver of any passing Goods, Cattle or Coal Train must render all the assistance in his power; and, if called upon to do so, must leave his own Train in a place of safety, and take on the Passenger Train. In like manner, the Driver of a Coal Train must assist or take on a

Assistance to disabled Trains.

Section H. Working of Trains

12. Duties of Station Managers, Supervisors, Shunters and Persons in Charge of Stations, Platforms or Yards (cont'd)

12.9.3 If a vehicle which requires repairs (other than repairs to the brake) is fit to travel, the C. & W./Maintenance staff will label it with a green "For Repairs" label on each side and the vehicle must be directed for repairs immediately upon discharge of the load.

12.9.4 If a vehicle has a defective brake but is otherwise fit to travel, the C. & W./Maintenance staff will label it on each side with a green "For Repairs" label with the appropriate red and white tab, as follows:—

(i) **Automatic brake defective—(pipe operative)**—vehicles so labelled must be regarded as "piped only" and may be marshalled in fitted trains or fitted portions of trains.

(ii) **Automatic brake and pipe defective**—vehicles so labelled must be regarded as unfitted.

(iii) **Hand brake defective**
(iv) **Automatic and hand brake defective** } —the brake levers on each side will be secured and vehicles so labelled must not be loose shunted.

13. Additional Duties of Station Managers, Supervisors, Shunters and Persons in Charge of Stations, Platforms or Yards

Applicable to Passenger, Empty Coaching Stock and Parcels Trains

13.1 Starting of passenger trains

13.1.1 A passenger train must not be permitted to leave any station before the advertised time. Station clocks must be checked daily.

13.1.2 The person in charge of the platform must give a signal to the Guard of the train to indicate when station work is complete, that the doors of all vehicles are properly closed and secured, and that the train is ready to leave. By day this signal must be given by raising one arm above the head, and at night, if the use of a handlamp is necessary, by a white light held steadily above the head.

13.1.3 When it is impossible for the Guard's "Ready to Start" signal to be seen by the Driver, the person in charge of the platform must, after satisfying himself that the signal has been given by the Guard, signal to the Driver accordingly.

13.2 Passenger trains not to stop where not booked to call

A passenger train must not be stopped to take up or set down passengers at stations at which it is not booked to call, unless specially authorised.

Fig 7 From the British Rail Rule Book, October 1972

Over the last century the information needed by people operating industrial systems such as railways has increased in complexity and quantity. It has also changed its purpose — the information in the 1972 Rule Book is not just intended to help railwaymen run trains, but it also represents trades union agreements, legal requirements, insurance conditions and so forth.

Table A

List of Scientific Terms, Concepts and Principles used in Unit 1

Taken as prerequisites			Introduced in this Unit			
1 Assumed from general knowledge	2 Introduced in previous Unit	Unit No.	3 Developed in this Unit or in its set book	Page No.	4 Developed in a later Unit	Unit No.
		S100[1]		Unit		
	radioisotope	6	electrophoresis	12	active site	2
	molecular weight (MW)	8	gel filtration	10	mitochondrion	3
	electrodes	9	specific activity	9		
	ions	9	criteria of purity	13		
	pH	9	unusual bases	20		
	amino acid	10	endopeptidase	15		
	apolar	10	exopeptidase	16		
	chiral	10	β-sheet	23		
	conformation	10	optical rotatory dispersion (ORD)	27		
	hydrogen bonding	10	base stacking	26		
	isomer	10	hypochromism	26		
	polar	10	side-groups	29		
	cellulose	13	apolar forces	29		
	cross-linking	13	polar side-groups	29		
	glucose	13	apolar side-groups	29		
	glycogen	13	ionic bonding	29		
	hydrolysis	13	random chains	29		
	macromolecule	13	active conformation	30		
	monomer	13	quaternary structure	30		
	peptide bond	13	subunit	30		
	polymer	13	sedimentation equilibrium method	14		
	polysaccharide	13	sedimentation velocity method	14		
	protein	13*				
	α-helix	14*		CS&F[2]		
	C-terminus	14*	subunit interactions	223		
	disulphide bond	14*	self-assembly	268		
	membrane	14	aided assembly	268		
	N-terminus	14*	directed assembly	268		
	organelles	14				
	primary structure	14*				
	secondary structure	14*				
	tertiary structure	14*				
	substrate	14				
	ultracentrifuge	14				
	enzymic activity	15				
	nucleic acid	17				
	nucleotide	17				
	DNA	17				
	RNA	17				
	mRNA	17				
	tRNA	17				
	X-ray crystallography	28				

**The terms marked with an asterisk in column 2, which were introduced in S100, Units 13 and 14, have also been developed in this Unit.*

[1] *The Open University (1971) S100* Science: A Foundation Course *The Open University Press.*

[2] *A. G. Loewy and P. Siekevitz (1969)* Cell Structure and Function *(2nd ed.) Holt, Rinehart and Winston.*

Fig 8

Although this is called 'Table A', there is no Table B or C! It appears by habit in every Open University Science text. Why number the columns? Why does column 1 appear at all? It is not really a table at all – there is no reading across to be done between columns. Presented as a list in three sections, it would take up less space and would not strain our sense of logic. This information has been structured inappropriately.

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Typographic Access Structures for Educational Texts

Robert Waller

in Kolers PA, Wrolstad ME and Bouma H (eds), *Processing of Visible Language*, vol 1, 1979, New York: Plenum Press.

The term "access structure" refers to the co-ordinated use of typographically signalled structural cues that help students to read texts using selective sampling strategies. In spite of their prevalence, however, the research literature contains very few references to access devices which include contents lists, headings, glossaries, and so on. This paper suggests some reasons for this and proposes that for research to be truly actionable it must be more firmly rooted in real-world problems. Evidence for the significance of selective reading is presented and some implications for research strategies are discussed.

If you were to compare an educational textbook and a novel, both in a language you do not know, you would very probably be able to tell them apart just by appearance. The novel will almost certainly consist solely of continuous prose. The text of the educational book, though, may be surrounded by additional pedagogical components, such as contents, index, glossary, summaries and so on. Why is the difference visible? It is not because the textbook has a structure and the novel has none. It is because the structure of the textbook has been typographically signalled, while the structure of the novel is signalled by linguistic means alone. So, whereas the typography of plain text can be evaluated by criteria of congeniality and legibility, the typography of textbooks clearly involves additional factors.

Consider the readers' problem if the contents list or index of this publication were to be laid out as continuous prose. If we accept at face value the conclusions of many studies in the field of reading, there would be few problems. The words would be legible, recognisable, comprehensible (by themselves), and memorisable. Although the page might look attractive, it would never-

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theless be completely unusable for its intended purpose. The problem would not be legibility so much as accessibility.

A contents list of index uses typographic layout and signalling to display structural (typically hierarchical) relations in its content. The structure of a complete book can be made accessible in a similar way. That is, typographically signalled devices can be used to help readers overview the text and locate relevant parts efficiently. To the list of such devices in the first paragraph might be added headings, concept maps, questions, study notes, and learning objectives. Used together in a co-ordinated way they comprise the access structure of a text.

Typographic signalling is not, of course, an inherent characteristic of all these devices. Much of the information they convey might well be communicated in the main explanatory discourse. That they often are signalled represents a prediction that publishers make about the purposes and strategies of readers. Whereas a continuous discourse assumes and perhaps enforces a relatively passive sequential reading strategy, a typographically structured text allows for more selective sampling. For example, when summarising paragraphs are embedded in the middle of a continuous text they are useful only to the reader who is reading the book through in a sequential way. If the paragraphs are typographically signalled, they can be easily accessed and used for text selection, previewing the argument, reference, and revision.

It might be thought that the various components of an access structure, being so prevalent in modern textbooks, would have been the focus of reasonably thorough experimentation. Instead, it is extraordinary that whereas innovative devices, such as the advance organiser or behavioural objectives, have been the subject of dozens of studies, there are only two or three papers that even mention headings as an aid to learners; and to my knowledge, no-one has yet looked at contents lists.

If it is accepted that there are circumstances in which readers may need to read selectively, then the models, theories, or methodologies used as the basis for empirical research should take this into account. This paper was prepared for a conference one of whose aims was to promote dialogue between psychologists and graphic designers interested in implementing research findings. It is therefore appropriate to examine why access devices have so rarely been featured in the research literature. Until they are, communications-media professionals will continue to complain with some justification that empirical research is not relevant to their needs.

What Practical Research has been done?

It would be a difficult task to classify all the research that has been published on texts. We are here primarily interested in studies that specifically aim to inform and evaluate the work of professional communicators. However, not only has a wide range of topics been identified for investigation but the purposes of researchers have differed greatly. Studies range from the highly theoretical to the pragmatic, from molecular issues to whole textbooks. Much of the research has investigated theories of memory, learning, or language processing and only incidentally the use of texts. Even research that is specifically concerned with text does not always aim at the same outcome. Frase (1973) has distinguished between three kinds of problem -- theoretical,

methodological, and practical. He points out the danger of interpreting research which is primarily intended to solve theoretical or methodological problems as the source of advice about practical instructional situations.

Prescriptive research on text presentation ranges from studies of legibility, dominated by the work of Tinker (1963), to work on content sequence and structure (Posner & Strike, 1976). Readability research investigates language variables such as vocabulary, syntax, and abstractness. The main body of work was summarised by Klare (1963). "Adjunct learning aids" describe devices that researchers have examined for their effectiveness in encouraging the recall of prose. These include "pre-instructional strategies" such as advance-organisers and objectives (Hartley & Davies, 1976) and in-text aids, usually questions (Anderson & Biddle, 1975). Much, but not all, of this research has been done in the context of Rothkopf's theory of mathemagenics (1970). The word is coined from the Greek and means "giving birth to learning." Studies of adjunct aids attempt to manipulate the readers' learning set in order to improve recall. A recent overview of the area is by Faw and Waller (1976).

Why is the Research not Successful?

It would seem at first sight that text researchers are covering a wide range of factors. Most of these areas, though, are currently receiving substantial criticism not only from potential users but from within. Contradictory or inconclusive results have been reported in a number of recent reviews -- for example, Duchastel and Merrill (1973) on objectives, Barnes and Clawson (1975) on advance organisers, Rickards (1977) on questions -- and a number of criticisms have been made of research, particularly that which aims to be prescriptive rather than descriptive.

First, research has been criticised for its lack of a sound theoretical base (Hartley & Burnhill, 1977 on typography; Rickards, 1977 on questions). Even the most widely-used frameworks fail to convince everybody (Carver, 1972 on mathemagenics; and reply by Rothkopf, 1974) or are misunderstood by those who use them -- Ausubel's "advance organiser" theory is particularly abused (Ausubel, 1963).

Second, methodology has been the focus of a great deal of criticism. The interpretation of results is made impossible by the wide variation among researchers in the variables they control and the experimental conditions that they report. In addition, a paper by Ladas (1973) demonstrates that different statistical techniques can be used to produce different results, using basically inconclusive data. Stokes (1978) presents evidence that questions the reliability of readability research.

Linked to problems of theory and methodology is the issue of representativeness. Since many real-world factors are missing in laboratory experiments, research results are often unreliable as a basis for instructional practice. Molecular issues may be convenient to study in a controlled context, but in real life they will often be swamped by other, more dominant, aspects of the learning environment. For example, Faw and Waller (1976) remark that the effect of the continued use of the innovative mathemagenic aids used for experiments has never been studied; yet it would seem that experience of using these devices would be an important determinant of their effectiveness. Thorndyke (1975) makes a similar point in relation to psycholinguistic

research. He suggests that where experimental situations are too far removed from normal experience, subjects may resort to special processing strategies. Snow (1974) demonstrated that the enormous range of variables present in a real-life instructional situation can never be completely replicated in a laboratory. Macdonald-Ross and Waller (1975), in addition, point out that the stimulus material used in many studies of typographic design fails to meet basic standards of clarity achieved by most professional graphic designers.

As far as practical communicators are concerned, these sorts of criticism imply that the outcomes of research are unactionable. Researchers have too rarely addressed questions that those who write, edit, and design textbooks actually need answers to.

Research and the Real World

The problems of theory and methodology are linked to the question of how representative the research on real world processes and events is. The relationship between research and the real world is discussed by Ravetz (1971), who offers an analysis of what he terms "ineffective and immature disciplines." His detailed comments echo the self-criticism heard in our own field of study. Rothkopf (1973) has written, for example, "We, the practitioners of an infant science, live in an age in which the elegant theoretical accomplishments of the advanced physical sciences are taken as the model for all scientific activity." He appeals for a return to the practical origins of science, saying that "Highly abstract conceptions of learning and teaching have not served the researcher's intuition well. They have distorted the sense of what questions are important and what results promise practicable contributions to schooling. As a consequence many research endeavours appear sterile and trivial."

As a solution, Rothkopf suggests that researchers need "cultural reconnaissance" into the real world. Ravetz cites the historical development of the now mature, positive sciences. He takes the view that immature disciplines could benefit from the former distinction between "history," "philosophy," and "arts." "Philosophy" meant reflection and explanation of the real world as described and classified by "history," while "arts" represented "the set of principles defining the methods of any class of tasks."

Such a reorientation would result not in any major change in experimental or statistical techniques, but in new research goals. Unlike the physical scientist's goal -- the definition of universal general laws -- the concept of "arts" would concentrate our efforts on identifying, refining, and testing techniques and methods. The quality control of applied research would involve the applicability of an idea to real-world situations in addition to laboratory experiments. This view does not deny the validity of all experimentation. The observation and classification that Ravetz calls "history" still needs experimental investigation into the basis of, for example, perception and cognition, but it does discourage what Anderson and Biddle (1976) call "mindless empiricism."

In Ravetz's view, knowledge in the immature disciplines is more realistically embodied in the form of aphorisms than universal general laws. Aphorisms are "where a craft knowledge finds verbal expression." They are not the perfectly validated, scientific knowledge that researchers in our field have failed to achieve. Where scientific knowledge claims to be generalisable

and value-free, aphorisms are unashamedly situation-specific and their values are openly admitted. Thus, according to the context of our problem, we are free to accept or reject them. They provide a framework in which to externalise and examine ideas and attitudes that would otherwise remain in the tacit domain.

In the field of typography the literature has always been aphoristic in nature --and the most interesting aspect of scientific research has often been its subjective element. The choice of issues is frequently more interesting than the actual results obtained. A compilation of typographic "commonsense" may be found in Zapf (1970) or Gerstner (1974). One may not agree with everything there, but will come away knowing a great deal more about typographic design. The role of empirical research is to monitor the effectiveness of the methods and techniques that aphoristic knowledge embodies, and provide an objective basis for observation of the real world of writers, books, and readers.

The Real World of Writers and Readers

What, then, are the characteristics of the real world on which research should be based? At present we are working with models that deal with only a fraction of its complexity, but which are relatively easy to investigate. For example, if we want to test the effectivensss of a particular text variable in improving learning, the criteria for successful learning (perhaps a high score in a comprehension test) will be determined by the experimenter. We could only extrapolate from such studies to situations where the achievement of predictable institutional goals was more important than the achievement of the students' personal goals. This, however, seems to deny the essence of the text medium: printed books are transportable and can be stored. That is, they can be used by people the author is not aware of and whose needs he cannot predict with any precision, and the reader is ultimately in control of the presentation sequence.

Studies of this sort seem to have a restricted view of the problems of textbook production and use. We may regain our perspective by looking at some of the other factors that in the real world of textbook publishing influence those whose job it is to oversee the production and evaluation process -- the editor, typographer, or educational adviser. The matrix in Figure 1 shows one way of representing their objectives. It is based on the assumption that all texts have a sponsor (author, publisher, etc.) and users. The ways in which these two groups influence the communicator's objectives are polarised in this diagram into positive purposes and negative constraints. The contents of the cells may, of course, vary. Although theorists and practitioners alike should ideally take account of factors appearing in all four cells, it is too often possible to identify a sort of professional tunnel-vision, that is not confined to applied psychologists. An example from the research literature is of the investigators who, often using incorrect terminology, have reported on the legibility of type without reference to particular typesetting systems. As Hartley and Burnhill (1977) point out, they have not addressed the questions typographers actually ask. They are thus quite firmly rooted in the user-constraints cell of the matrix. An example from the practitioners' side is of the many editorial house-styles that attempt to impose standard formats, presentation styles, and printing methods on publications without regard for

	PURPOSES	CONSTRAINTS
USER	Decide to/not to use Search for particular item Study in depth Browse Recap/review Entertainment etc.	Physiological (legibility, weight of book) Psychological (reading skills, aptitude, previous knowledge) Availability (delivery, storage etc.) etc.
SPONSOR	Teach particular curriculum Persuade Enrich readers' outlook Personal fulfilment Sell books etc.	Production costs Legal factors (libel, copyright etc.) Technology Standard procedures (house-style, standard forms, etc.) etc.

Figure 1. The sources of textbook designers' objectives.

the nature of particular target readerships. The application of standards and rules that cannot be justified by reasons other than tradition alone places such house-styles in the sponsor-constraint cell.

This matrix demonstrates a significant omission in the advice that is available to producers of texts, either through research literature or the traditional practices of publishing. The issues raised by the user-purposes cell have not been dealt with. Information is available about most items in the constraints cells, while the sponsor-purposes cell has dominated instructional research with its stress on the achievement of institutional goals. However, the notion that users may approach texts for many different purposes has usually been overlooked in the reduction of the real world to theoretical models for controlled experiment. There is evidence, though, that although text is on the whole a linear sequential medium, it is likely to be read in a far from linear fashion.

Evidence of Selective Reading Strategies

The authors of some kinds of texts can make strong predictions about their readers. Novelists, for example, have a self-selecting readership who appreciate and understand their style. The authors of programmed-learning texts can, by entry tests, predict their readers' prior knowledge and ability. However, conventional textbooks are open to anyone, and authors know comparatively little about the abilities, purposes, opinions, prior knowledge, and circumstances of their readers. In fact, the only reading behaviour that they

can confidently predict is that their readers must read selectively. We can cite a number of factors as evidence for this assertion.

First, observation of reading styles and strategies by Pugh (1975) and Thomas (1976) shows that a straight-through linear strategy is not typical of efficient readers. Pugh links selectivity with reading efficiency. He lists five strategies of efficient readers (defined as those whose purpose is known and who achieve that purpose). Three of them are selective activities concerned with locating and making decisions about the content of a text. Indeed, writers on reading and study skills commonly recommend that students read in a selective fashion, previewing texts by scanning ahead and selecting particular areas for special attention.

Second, research on learning styles may be cited (Cronbach & Snow, 1976). If material is presented to suit a particular kind of learner, it may be unnecessarily difficult for those who adopt a different style. Mager (1961) found that instructional sequences planned by instructors were usually quite different from those elicited from learners. Indeed, the prevailing philosophy among educational theorists appears to have shifted from the highly directed, manipulative style of education exemplified by programmed learning, towards a more open facilitative approach. Increasingly, the emphasis is on enabling students to formulate and achieve their own objectives rather than those prescribed by institutionalised education. In addition to preferred learning styles, individuals study at different rates and, in courses overloaded with impossibly long reading lists, must adopt highly selective reading strategies.

Further evidence that readership is unpredictable is indicated in the way that textbooks are marketed. At the tertiary, and to some extent the secondary, level they are sold internationally. They are therefore likely to be read by people whose cultural background, even whose mother-tongue, is different from that of the author and his immediately perceived readership. Linked to this is the important growth of interdisciplinary studies which brings readers from widely differing educational backgrounds to the same texts.

Both the Pugh and the Thomas studies mentioned above arose from courses designed to help students read more efficiently. In both studies it was found that otherwise fluent readers often found difficulty in using books effectively as resources. It is interesting, though, to compare approaches to the teaching of reading skills at the middle and secondary school levels and at the tertiary level. At the lower levels, efforts at improving the text-reader interaction are often made on both sides; that is, texts are carefully selected, often with the aid of readability formulae, and students are given instruction in spelling, vocabulary, grammar, and so forth. At the higher level, students are assumed to be fluent readers and instruction centres around study skills. However, a corresponding selection of textbooks is rarely made at that level. While readability research deals with the same text-difficulty variables found among children in schools, there is a noticeable mismatch at the tertiary level between research on reading problems and research on text presentation.

Why has Selective Reading been Ignored?

There are probably several reasons for this apparent mismatch. Hartley and Davies (1976) suggest that the comparative absence of research on overviews in texts (which could aid selective readers) may be because their worth is

so obvious "that few people have felt any real need to subject the concept to empirical investigation." However, that has not deterred researchers from investigating other "obvious" ideas. Instead we may recall Frase (1973) who was quoted earlier as saying that practical research on text has often arisen out of theories on learning, or out of the development of existing methodologies and has been concerned with books and readers only incidentally.

Many examples of theory-driven research are found in the field of reading. The size of the research effort on reading is out of proportion to the difficulty in either teaching or practising it, but it is full of issues that are intriguing to the psychologist -- issues of perception, language, learning and so on.

In the same review of learning from prose, Frase gives an example of methodology-driven research. He notes that many of the research designs prevented readers from reviewing the text they had read before answering the test questions. Although this unnatural reading strategy allowed the experimenter to attribute differences in performance to, say, question position, it would be difficult to extrapolate their findings for normal instructional purposes. In addition, experimenters make a tacit value-judgement when they use retention as the sole criterion of success in the study of text, whether the form is multi-choice questions or experimenter-marked free-recall scripts. It is methodologically convenient to ignore other kinds of reading outcome.

Appropriate Research Methods for Access Structures

What would truly practical "arts"-driven research, that access-structures require, involve? It would probably be methodologically less neat; it would also be based on theories that are imprecise about cognitive processes, but which look at broader aspects of reading than has been customary.

Hatt (1976) reviewed some of the existing models of the reading process and commented how many of them take the coming together of the reader and the text as "given"; theorists have been almost solely concerned with letter and word recognition issues. With the level of fluency expected from textbook readers though, there are likely to be few such problems. Instead it would be interesting to have a more comprehensive framework for discussing the reading process so that the effect of broader aspects of text, such as the access structure, on reading behaviour might be predicted.

Hatt attempts such a framework, and it is deceptively simple. It is based on three stages: a reader finds a text; he reads the text; he uses the message (or not, as the case may be). As we have argued, many theorists confine themselves to the cognitive processes that occur within the second stage, though most now reject the early information-processing model (transmitter-message-receiver) as casting the reader in an unduly passive role. Instead we now see readers as not simply receiving information but as seeking and finding it. Kintsch (1977) summarises the theory of selective attention. Hatt extends these ideas by studying patterns of entry and patterns of exit from the reading act.

For our purposes Hatt's framework appears unduly sequential. It may be that aspects of all three of his behaviours can occur cyclically or simultaneously. So Hatt's stages may be termed "motivation," "strategy," and "outcome." All three parts are "ongoing" rather than sequential. Thus reading

cannot continue satisfactorily if there is no motivation, no effective strategy, or no outcome perceived by the reader. Some factors that such a model would have to consider are listed in Figure 2.

Consider a reader-text mismatch in the readability level of the text. The syntax and vocabulary may be too difficult for a particular student who has done no full-time study previously, or for whom English is a second language. We can anticipate that this will demotivate him (he will not enjoy reading or feel he is achieving enough), it will slow him down (prevent him from skimming, perhaps), and may result in a less satisfactory learning outcome (he may miss subtleties, or not perceive the overall structure of the argument).

A mismatch in the access structure of the text would also affect all three aspects of reading behaviour. Since he cannot overview the content, it might be difficult for the student to see the relevance of the text to his needs. It will restrict his reading style because it assumes a passive linear strategy that he may not have enough time for. It will restrict learning since the text, having no surface structure, offers him no aids to memory.

Successful research on access devices would have to report on many of these factors. Only then could practical communicators determine the applicability of research observations to their own situations. There are indications that research strategies, broader in scope than those we have reviewed, are emerging.

MOTIVATION	STRATEGY	OUTCOME
Attention	Reading style	Goal achievement
recommendation	browse	personal
obligation	skim/preview	objectives
attraction	search/scan	
	intense study	course
Selection	review	assessment
relevance to:		
course objectives	Purpose	Knowledge
personal objectives	criticise	memory
flavour	memorise	insights
context	revise	skills
register	understand	
	assignment	Pleasure
Perseverance	make notes	amusement
enjoyment		excitement
achievement	Environment	fascination
	home, library, etc.	
	distractions	
	lighting, health	
	comfort, etc.	

Figure 2. Three aspects of the reading process.

Research, using appropriate measurements, should seek ways of observing reading behaviour, rather than simply measuring specific outcomes such as retention. A past problem has been that traditional eye-movement recording techniques, in addition to being expensive, elaborate to set up, and obtrusive to the reader, have been biassed towards micro-level reading. Recently, though, Whalley and Fleming (1975) and Pugh (this volume) have reported simple macro-level reading recorders which allow a relatively natural reading situation.

Behavioural records, of course, need sensitive interpretation. Whalley (1977) has proposed a research paradigm that calls for: the linking of reading records to formal structural analysis of text; subjective evaluation of text structure elicited from readers; and normal performance measures such as multi-choice texts, essays, and verbal protocols. Shebilske and Reid (this volume) have also reported studies of macro-level reading strategies related to structural analysis of text.

What Structure is to be Accessed?

The link between behavioural records of the reading process and the formal analysis of text structure makes this work of great practical interest. If the reader is, in fact, an active participant in the communication process, we are challenged to investigate ways of presenting texts that give readers a reliable basis for sensible sampling. If access is to be provided with headings, contents lists, and so on, they need to be related logically and consistently to the structure of the text and to each other.

This relationship is hard to define for some presentation devices that have been explored. Those based on research that obliges readers to adopt a linear sequential strategy -- adjunct questions or advance organisers, for example -- are essentially rhetorical devices; they are designed to influence the reader's concepts and facts as they are presented. In this sense they are conceptually indistinct from other aspects of argumentation that texts contain.

It is hoped that the rationale of access structures is more sound -- they are typographically signalled in order to be spotted by the skimming, searching, or browsing reader. Even so, how do these various graphic techniques relate to the transitional, organising, or signposting cues that are among the conventions of prose? While the mathemagenics-type research needs to know because in some ways it proposes a rival system, the designer of access devices needs to know what he is structuring. Linguistic cues are important because they may provide the key to such an analysis. In the field of cognitive psychology, a number of recent studies that employ story grammars to describe the structure of prose may be cited. There is no comprehensive review yet, but the studies by Thorndyke (1975) and Meyer (1975) are examples. This work is linked to the studies of linguists working at the inter-sentence level of text (Grimes, 1974). It is to be hoped that this effort will eventually lead to a workable system of text analysis for practical purposes. At present it is probably still too detailed to be used conveniently with large amounts of text.

When a usable macro-level system of text analysis is formulated, there will still be unanswered questions. What structures are appropriate for particular subject-areas, the teaching of particular skills, or for different

educational levels? Indeed, is it even possible to arrive at such generalisations? A further question might be: how can the clarification, through headings, of a single overall structure help students with many different needs? An access structure cannot make a poor text good, nor can it ensure that an author perceives the various needs of his readership correctly. It does, though, help the reader make informed decisions about strategies for coping with texts that may not be directly aimed at him or her.

Each device in the access structure fills a need that cannot be met in another way: the contents page and headings give an overview of the text; glossaries provide definitions of terms; the index is the means of direct access to concepts appearing in the text; a list of objectives displays the anticipated purposes of the text; opening summaries give more detailed overviews of the arguments than simple headings; and final summaries present the conclusions. A less traditional device, the concept map, shows the structure of a subject area (not the same as the text-structure which is constrained by the linearity of the medium).

In conclusion it may be said that research on access structures is proposed in reaction to some of the problems encountered by other kinds of research on text. Methodological problems will not disappear but research on access for selective reading, by having different and in some ways less ambitious goals, may avoid some of the pitfalls. Instead of investigating the effect of particular aspects of texts on memory or the learning process, it may be more appropriate to ask conceptually less rigorous but practically based questions. What sort of presentation is found most acceptable by particular groups of readers, and in what circumstances? How are reading strategies influenced by particular text arrangements?

Our criterion of actionability calls for research on the writer as much as research on the reader. In other words, research on presentation should aim to offer usable methods of text construction as well as describe the effect on learners. That these devices, used correctly, are helpful to readers is hard to dispute -- empirical research on the issue would be self-fulfilling. But although the products of authors are being investigated, little is known about the writing process. How can authors be helped to produce coherent access structures? It is hoped that the effort to answer such questions will lead to useful research in the real world of writers, editors, designers, and readers of textbooks.

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Graphic aspects of complex texts: Typography as macro-punctuation

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A case is made for the inclusion of graphic and spatial factors in the linguistic analysis of text, and in common rules and guidelines for clear writing. Some conceptual problems are considered and a parallel is drawn between the roles of punctuation and typography at the micro- and macro-levels of texts. The gradual codification of punctuation, from the original vernacular through an elocutionary or stylistic role to a well-specified syntactic role, is suggested as an indication of a direction for future typographic analysis.

The study of typography as a functional component of written communication has a relatively short history. Consequently, we have a rather poor armoury of concepts, definitions, metaphors, or frameworks with which to handle a subject area that straddles the critical frontiers between verbal and graphic communication, the writer and the reader, and creative writing and the manufacture of print.

This paper neither reports data nor discusses methodology; rather, it attempts by model and metaphor to establish a background necessary for the formulation of sensible research questions and the design of productive experiments.

Typographic study has suffered from the distinction drawn between two meanings of the word "writing": its literary sense (composing) as distinct from its graphic sense (making meaningful marks). Thus we can "write" (literarily) a speech or a broadcast and we can "write" (graphically) a complex mathematical equation. The one is a transcription of words for which graphic form is simply a recording medium, the other cannot be well encoded verbally and its spatial qualities comprise a syntax.

The majority of printed materials fall into neither of these extreme categories. A typical educational text, for example, consists of a number of verbal sequences, together with illustrative and tabular displays, the organization of which is achieved both by cross-reference and by graphic and spatial arrangement on the page and in the book. The contribution made by typography here is at the "macro" level of text organization, as distinct from the "micro" level that occurs within a linear sequence (such as the mathematical formula).

In the past, typography has been too readily defined in simple operational terms as "what typographers do." Because, for various historical and managerial reasons, the professional activity of typographers is normally confined to the graphic treatment of a (literarily) finished text, we thereby reduce it, in theoretical terms as well, to a largely decorative role. In so doing, we ignore the fact that the "finished" text almost certainly uses many typographic organizational

options such as footnotes, headings, captions, lists, and tables. For all these devices, spatial and graphic distinctions are of the essence. However, while rules for the composition of graphically simple verbal sequences exist in usages, and have been described in grammers, the state of typographic theory is relatively primitive. That is, although rules of some kind may exist (and, of course, it is by no means certain that they do) they have not yet been formally codified. Consequently, there is no assurance that writers, or indeed typographers, use typographic options consistently; there is no well-argued and theoretically-sound source of guidance for the composition or evaluation of complex text; and there is no consistent set of rules on which to base the kind of effective-reading instruction that advises students to make sensible use of visually signalled text structure.

For many years linguistics was confined almost exclusively to intra-sentence analysis but recently more attention has been given to the structure of entire texts and discourses. Some of this work has been inspired by the application of computers to language study. Research on machine translation and artificial intelligence has suggested that the interpretation of stories and arguments is governed by grammar-like rules, and that computers must be programmed with these rules, together with contextually relevant background "knowledge," before they can process even the simplest text. The application of computers to practical text-handling (typesetting, editing, and design) may have a similar effect on typography, imposing a similar degree of discipline on our thinking. Text-processing systems offer typographic menus that restrict users to a limited range of options. The quality of such systems will depend on the analysis on which they are based.

A further demand for the codification of a greater part of typographic practice will come from legislators. The "plain English" laws now being passed in a number of states in the U.S.A. are likely the pattern for the future and they will probably encompass graphic as well as linguistic factors of document design.

Such developments will require us to systematize aspects of text presentation that we have previously been content to leave completely to intuition. This is not as great a threat to the graphic designer as it appears. The existence of grammatical rules has not diminished the art of writing and the production of effective documents will always require sophisticated personal skills. The concerned designer will welcome any means whereby the reliability and quality of his products might be assured, and his professional skills might be more fully integrated into our general concept of literacy.

Text and speech

The definitional distinction between written and spoken discourse is, plainly, that the first is encoded in graphic marks on a surface or field, while the second is encoded in sound. At the micro-linguistic (word) level the phonic and graphic

media are adequately equivalent but, at the broader level of discourse, significant differences are found. With some exceptions, such as text-like speech (a scripted monologue, for instance) or speech-like text (a spontaneous personal letter), the two forms of discourse, and their sub-varieties, display distinct forms of argument, syntax, and other stylistic variables less easily described. Distinctions of this sort stem not so much from the cognitive differences between reading and listening, or talking and writing, as from the strategic implications of the separation of writer and reader in time and place.

All language is artificial, written language especially so. The degree to which language systems are natural or innate is debatable but there is no doubt that any particular discourse is a constructed affair, derived from the linguistic and cognitive competencies and the social and information needs of its participants. Speech and text relate to the same lexical and syntactic base but an effective performance in either medium requires mastery of contextual and pragmatic factors that lie outside the language and are often peculiar to a particular situation or subject. Competence in speech is acquired more or less naturally, and in normal conversation there are opportunities to query, repeat, or rephrase information. In text, however, clear explanation of complex events (journalism), sciences (schoolbooks), regulations (government documents), or instructions (technical manuals) is an enormously skilled task that few master thoroughly. Studies by Baldwin and Coady (1978) seem to reinforce this view of the artificiality of written language; they found that punctuation—an artificial, non-verbal syntactic aid—had little effect on the comprehension of text by young children but was an acquired and relatively sophisticated skill developed only by older, more experienced readers. There is no lack of evidence that even highly-skilled readers can suffer from the poor standard of writing resulting from a process of education that teaches the established formalities of English grammar to the exclusion of less well-documented communication strategies.

So, while speech is on the whole spontaneous, text is a planned communication and makes a series of assumptions and predictions about the reader. It is, therefore, the product of a design process; and whereas the production of a text involves predictions ranging from the reader's knowledge and purposes to his or her eyesight or the size of the bookshelf, clearly our concept of "design" must refer not only to the visual appearance of the document but to all aspects of information defined in the broadest manner. If "literacy" may be taken to refer to the skilled use of the written word, it is as much a design as a linguistic skill. A fully literate writer, then, is one who has mastered not only conventional grammar (rules for the construction of language that are divorced from either the spoken or the written context) but also the full implications of the "written-ness" of language that is, the constraints and opportunities that result from, first, the separation between the writer and his or her readers and, second, the physical and visual nature of documents and graphic language.

Writers and readers, speakers and listeners

Wright (1979) reports that many people prefer to ask someone for information rather than look it up in a book or pamphlet. For example, a person needing information about his or her eligibility for welfare is normally well advised to ask about it rather than attempt to interpret a complex document. The clerk can ask a series of questions about the enquirer's status and quickly give the correct ruling. To rely on the equivalent written information requires careful sifting of the relevant information from a maze of conditional explanations intended to serve many enquirers with a wide range of questions and backgrounds. In face-to-face conversation the expert can eliminate large amounts of irrelevant detail with each question but in the document the individual reader carries the whole burden of search and interpretation.

An appreciation of this type of problem as distinct, for example, from that of purely narrative or descriptive text leads us to treat with caution over-simple models of communication. It is common (for example Guirard, 1968) to find the communication process modelled as a simple one-way transmission of a message from a sender to a receiver, with various embellishments to describe more detailed models of the encoding, transmitting, and decoding mechanisms. Many such models were published (Johnson and Klare, 1961) during the years following the appearance of Shannon and Weaver's (1949) information theory. They were attractive because their mathematical origins gave them a certain scientific status but, although we can identify analogous components in electronic signalling systems and networks of purposive human beings, there is no reason to suppose that they operate in the same way (Waller, 1979).

An inappropriate model can bias the way a subject is researched and taught. In graphic design the prevalence of poorly-posed research questions, with consequently inoperable results, has regrettably turned most practitioners and teachers away from educational psychology as a source of theory and data. A text is not merely a psycholinguistic phenomenon. It is also a physical artefact, the product of writing and publishing processes, and a component in the user's life. A model of textual communication that accounts for all graphically organized text features must relate to these broader, pragmatic issues.

I have argued that because writer and reader are separated in time and place, text plays a role in their relationship quite different from that of speech. Text differs from speech first to compensate for the poverty of prose in comparison with certain aspects of dialogue and second to capitalize on its relative superiority.

The poverty of prose stems from the lack of opportunity for immediate feedback to the communicator about whether or not his or her audience regards the message as relevant, comprehensible, credible, or persuasive. Authors can make fewer accurate assumptions about the pragmatics of communication—the context, purposes, and knowledge of their readers. Explanatory or instructional

text therefore contains frequent interpolations in the form of digressions, overviews, conditionals, definitions, and recapitulations, to answer a wide range of anticipated queries from readers. These exist in spoken discourse, too, but they can be tailored to fit a particular audience or to respond to specific feedback cues. Instructional text consists of prose treated graphically and spatially to enable readers to handle its organizational complexity.

The relative superiority of text lies in its physical nature: it provides a permanent organized record that allows analysis, criticism, refinement, reflection, and review, permitting private study and the economical distribution of information.

In direct conversation language is only one element in our recognition and comprehension of another person. A text must completely replace that other, to become a surrogate reader for writer and vice versa. The written-ness of language, its typographic and spatial nature, can be seen from these two perspectives: for the writer it has primarily a rhetorical function, enhancing the available means of expression; for the reader it has an additional access function, enabling the purposive, reflective, and selective use of texts and enhancing the available means of enquiry.

As Table 1 illustrates, some typographically signalled devices are exclusively components of text-as-argument, while others belong to text-as-artefact; many can be placed in both schemas. A typical textbook is, then, a complex system of intermeshed components, some arranged in a simple sequential order, but many displayed in parallel with other components or dispersed throughout the text.

Because this organized complexity of function and structure has no direct equivalent in unscripted spoken discourse, conventions or rules for its display will not be found in natural language. And, because graphic language is thus artificial, such rules must derive from some consideration of the source of that artificiality: the practical aspects of writing and printing systems.

Codifying rules for graphic language

The formal codification of English orthography was relatively recent. The development of letterforms was to a large degree frozen by the spread of printing and it was only during the seventeenth and eighteenth centuries after many years of vernacular development in which a wide variety of forms was in use that English spelling and punctuation were standardized. The codification of punctuation suggests an interesting parallel with typography. Punctuation is the single aspect of written language, for which grammatical rules exist, that does not represent words themselves but the spaces between them. It is, then, an organizational system at the micro-text level functioning in much the same way as typographic signals and the use of space at the macro-text level.

Table 1. Some functions of the typographic organization of text.

Rhetorical functions	
About the argument	summarization (title, summary)
	introduction (foreword, preface, introduction)
Within the argument	emphasis (underlining, italics, etc.)
	transition (headings, space, etc.)
	bifurcation (alternative options, parallel texts, interpolation sections)
Extra to the argument	substantiation (footnotes, appendices, references)
	addenda (apologia, acknowledgements, etc.)
Access functions	
About the book	overviews (contents list, abstract)
	definitives (glossary, index)
	identifiers (title, author, style)
Within the book	locators (topical headings, typographic signalling)
	descriptors (functional headings, captions)
Extra to the book	study guidance (recommended reading, exercises)

Early grammarians regarded punctuation as an elocutionary aid, denoting breathing spaces, pauses for dramatic effect, and cues for special intonations or voices required of the reader (as in exclamation, interrogation, and quotation marks, and the "irony mark" proposed by several early linguists). For many years reading was usually vocalized; silent reading is surprisingly recent

(Pugh, 1975). During the late seventeenth and eighteenth centuries, writers of treatises on grammar began to develop a syntactic function for punctuation distinct from indications of timing, breathing, and voice. The various kinds of period—full point, comma, semi-colon, and colon—rather than denoting relative lengths of pauses, were seen as making syntactically distinct kinds of transitions within and between sentences. Honan (1960) describes how, in the nineteenth century, attempts to inject order and consistency into the use of punctuation led to the complete rejection of elocutionary theories and the description (or, to some, the imposition) of elaborate rules for syntactic punctuation.

At the same time, greater interest was also being shown in purely graphic aspects of text that did not share even the elocutionary link with spoken language: for example, the use of asterisks, matrices, braces, and oblique strokes to organize language spatially and the use of alternative type styles to differentiate text components. This interest was not carried very far, however, and grammarians neither developed rules for these devices nor suggested a place for them in a theory of linguistics.

Cohen (1977) remarks on the attention given to graphic factors by early linguists: "The language texts of the period [1640-1785], reflecting an effort to represent the obvious sense of the written language, include sections on punctuation, capitalization, and often, handwriting and type styles. These sections are significantly prominent" (p. 50). If modern complex instructional texts, maintenance manuals, or government regulations had existed at that time, it seems entirely possible that those linguists would have encompassed in their theories some of the typographic components discussed above.

In contrast, it is hard to find one modern general linguistics textbook that even mentions punctuation. Those linguists who do consider graphic factors are from more recent branches like stylistics (Crystal & Davy, 1969) or text linguistics (Werlich, 1976), although neither develops the topic to any depth. Where modern linguists study language as a key to understanding human thought, early linguists saw it primarily as a representation of reality.

Typography as macro-punctuation

Punctuation literally means "pointing," and refers specifically to the use of such marks as the full point, comma, and so on. However, many of the effects achieved by punctuation can also be achieved by other means. For example, a comment that appears in parentheses might just as well appear in a footnote and, indeed, if it is a particularly long comment or quotation it normally is footnoted or may even appear in an appendix. Most other types of punctuation also seem to have equivalents at the macro-text level. Table 2 displays four common functions of punctuation for which there are corresponding devices at the micro- and macro-text levels.

Table 2. Some functions of micro- and macro-punctuation.

	Micro-level	Macro-level
Delineation	initial capital full point comma semi-colon colon	headings title pages space rules
Interpolation	parentheses dashes commas	footnotes boxed inserts marginalia indentation
Serialization	commas semi-colons oblique strokes bullets numerals	headings, numerals tabular format regular spacing/styling
Stylization	quotation marks exclamation marks question marks	size variation style variation layout variation

Delineation refers to methods of indicating the beginning and end of text segments, ranging from clauses (which can be bounded by commas), through sentences (bounded by initial capitals and full points), paragraphs, chapters, parts, and ultimately, to books (bounded by covers).

Interpolation refers to the insertion or juxtaposition of a short segment into a longer one in such a way that the continuity of the sentence, paragraph, page, chapter, or book is not destroyed.

Serialization refers to the organization of segments into clear structures, sets, or series. For example, this paragraph is one of a set of four that is signalled simply by the linguistic rhythm of the first two words; the set could have been numbered, bulleted, or typographically distinguished from the rest of the text.

Stylization refers to the indication of a mode of discourse differing in voice or genre from the main body of text.

Delineation and stylization have obvious equivalents in spoken language:

delineation similar to the beginning and end of a segment of discourse, stylization having parallels with vocal tone or quality. Complex serialization is less easy to achieve in speech though possible because it refers to sequential aspects of language. Interpolation is particularly interesting because it includes a number of communication strategies that are purely spatial.

Complex text, broadly defined, typically comprises instructions, regulations, classifications, and procedures rather than simple narratives or descriptions; it serves a variety of readers with different needs and purposes; and it is a component of a larger system, industrial, administrative, or educational. Such text rarely has a single author and is often altered or enlarged to reflect new developments in the system, often without an overall review for many years. In effect, then, it contains a large number of embedded conditionals, definitions, digressions, quotations, and other interpolations that, in attempting to solve a wide variety of problems, increase the difficulties for the individual who must separate his or her requirements from those of others.

Because our concept of writing is basically non-graphic, spatial or typographic solutions tend to be used as a last resort: government documents often have boxed inserts containing warnings about the penalties for supplying incorrect information or reminders to sign or read a particular item. Instead of this "lifebelt" approach to the bemused reader, the document, or even the system to which it relates, should be completely redesigned.

A number of fairly radical graphic solutions have been proposed. One of the best known but least used is the ordinary-language algorithm (Lewis, Horabin, & Gane, 1967), which breaks down conditional information (if—then—unless constructions) into simple yes—no questions spatially arrayed in branching sequences. Educational texts frequently contain "concept maps," flow or systems diagrams of the text content that enable readers to see its structure independently of the precise sequence into which the writer has ordered it. Side headings or marginal notes are frequently used to similar effect. They enable the writer, or a commentator, teacher, or editor, to present a viewpoint, structure, or commentary separate from that provided by the author. In this sense, especially if they are so long as almost to rival the main discourse, they can be described as "parallel texts."

Parallel texts, the parallel juxtaposition of two or more texts on the same page, is a technique of language display that has flourished in the past. Medieval books frequently presented classic or sacred texts accompanied by a commentary. There are a number of books which have been overlayed with several generations of commentary, and commentary on the commentary, by a number of different readers. Contemporary parallel texts combine a variety of different text types. For example, texts with an unusually large number of footnotes have occasionally been "legitimized" by a parallel two-column layout; a popular electronics magazine recently published an article in three different but parallel versions that

referred to the same concepts and illustrations and were addressed respectively to the beginner, the scientist/expert, and the hobbyist wishing to construct the apparatus. A recent "futures" book interwove several perspectives on the same subject by using colour-coded pages throughout.

Work is still in progress on the analysis of parallel texts (how authors modify their linguistic signals in response to format and typographic options, how parallel texts relate to one another and indicate that relationship) but there is little doubt that exploiting such graphic opportunities for organizing information, displaying relationships and overviewing arguments, communicators can usefully extend the conventions of text beyond the linear form of spoken language.

Problems of description and analysis

Although the categories in Table 2 are neither exhaustive in content nor discrete in function, they represent a minimum set of structural concepts with which to handle visually complex text. In addition to the common devices and techniques listed, there are numerous typographic effects that remain unclassified and unnamed. For the linguist who wishes to include typographic factors in text analysis there are both simple practical problems of describing and naming typographic variables and interpretative problems of typographic semantics.

The only existing system for describing typography on which there is a large measure of agreement is that of technical specification in the printing industry. Even there it is not always possible for the designer to specify his intentions using only a limited set of proof-correction marks and technical instructions; he must often provide a drawing for the typesetter. Mountford (personal communication) has identified ten categories of graphic-linguistic devices for inclusion in the linguistic analysis of text, although problems still remain: incorporating those devices in linguistic notation, and describing them in purely linguistic terms to the exclusion of functional factors such as book production and information location. In a personal communication, Twyman notes that he is developing a system that may overcome the notational problem. It is restricted to characters available on a standard typewriter and thus obviates the need for the expensive and difficult reproduction of original documents. It is also content-free and technology-free: it can be used with other systems of linguistic description and is not confined to the limitation of a particular typesetting system.

The problems of typographic semantics have already been implied: there is no agreement about what typographic conventions mean, there is no consistency in their use, and in practical analysis there is even doubt that the phenomenon investigated actually carries a meaning in the ordinary sense of the word.

Table 3 contrasts four sources of graphic effects. Any particular graphic device or example of graphic organization may display a combination of these in a way that defeats a simple analysis of their purpose or function.

Graphic aspects of complex texts

Table 3. Semantic confusions in typography.

Graphic effects	Semantic status
Conventional	Denotative
Representational	Onomatopoetic
Associational	Connotative
Artefactual	(none)
Positional	Syntactic and performative

Conventional effects are those that have arisen for a number of historical or accidental reasons (including other factors in this table), but which have acquired a meaning about which there is general agreement. In conventional graphic effects there is a visually arbitrary relationship between the graphic symbol, or effect, and its referent. For example, the letters of the alphabet are conventional, bearing no obvious relationship to the sound patterns of speech.

Representational effects are those that have some correspondence with visual experience or some relationship to sounds. For example, the use of bold type for emphasis reflects vocal stress, and musical notation reflects the use of the "up-down" metaphor in the description of music.

Associational effects result from stylization, exploiting graphic motifs originating from one of the other factors in this schema. They are responses to social conventions or aesthetic preferences that become attached to particular graphic effects. For example, the use of copperplate script on items purporting to be valuable (such as guarantee certificates) imitates the original functional use of such lettering in security printing and banknotes.

Artefactual effects result from the fact that a text is a manufactured object. Thus, many of the graphic features of a text that might be mistaken as having some quasi-linguistic intent can be explained in this way. For example, the choice of a typeface may result from the limitations of a printing system: bold type is absent from typewritten material simply because it is not available on a typewriter; and the amount of text or illustrative material that can be placed on a page is limited by the size of that page. Garland (1979) distinguishes between the influence on the form of a diagram of, first, the physical nature of the diagram, its contents, and external constraints of format (its "shape"), and, second, the use of a model, example, or accepted diagram convention (its "pattern").

Positional effects, the relative positions of text components on the page

or in a book, can relate to the performative nature of writing and reading. That is, in addition to the syntactic correctness or clarity of a particular sequence of components, their position may relate to an anticipated pattern of the reader in studying or using texts. An index is placed at the end of a book for easy reference; scientific journals frequently place their contents list on the front cover for ease of scanning; and page numbers and other similar reference devices have a purely performative function.

It is because of such potential confusions that successful analysis of typography will never be a simple mechanical process. It requires the same kind of personal skills and sensitivity as linguistic or literary analysis, even if the material examined is less profound. The student of verbal language is alert for metaphor, irony, or idiom, and does not attribute to coughs, grunts, or stutters the same kind of meaning as to words. The typographer also must be aware of the influences of cultural norms, stylistic associations, and technical constraints on the visual form of texts.

Conclusion

A case has been proposed for including typographic and spatial factors in the linguistic analysis of complex text. The problems, though, are numerous. Typography is not simply a linguistic phenomenon but reflects the problems of communicating across time and place through a manufactured medium. Although the difficulties involved in analysing and describing the relationship of discourse to its graphic array are challenging, they are not insurmountable, and the more skilful use of textual communication that might follow from such an effort would lead to considerable social and educational benefits.

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